DURABILITY OF ROCKS UNDER TROPICAL CONDITIONS

MASTER OF PHILOSOPHY

GAN VIDANELAGE INDUTILAK SAMARADIVAKARA

DEPARTMENT OF EARTH RESOURCES ENGINEERING
UNIVERSITY OF MORATUWA
SRI LANKA

June 2006

DECLARATION

The work included in the thesis in part or whole has not been submitted for any other academic qualification at any institution.

.....
G.V.I. Samaradivakara

Certified

.....
Professor P.G.R. Dharmaratne

.....
Dr. U.G.A. Puswewala

ABSTRACT

Sri Lanka has a basement rock formation of metamorphic origin that the majority is gneissic type, which is intensively used in many of the civil engineering constructions. In addition, foundations of most of the important civil engineering structures are extended up to or into the fresh gneissic rock strata.

Sri Lanka has a tropical climate. Therefore the study on durability of gneissic rocks under tropical conditions would be immensely beneficial to the construction industry of the country.

The simulation of exact natural weathering conditions is quite complicated. This study concentrates mainly on how heat stress affects deterioration of index properties of gneissic rocks.

When the rock mass gets heated, and cooled rapidly due to sudden rainfall, there is a possibility of propagating micro-fractures in the rock mass which will initiate weakening the strength properties of the rock mass.

Most of the bridge abutments and dam constructions are associated with basement rock. In such locations rocks mass is alternately subjected to wetting and drying processes. Therefore the deterioration of rock resulting in its breakup, which is termed as "slaking" is also studied in this research.

One hundred and sixty rock samples of gneissic rock of diameter 54mm (NX size) are tested in this research. Out of these 132 samples are fresh competent rocks and 28 are weathered to different degrees. These samples are selected from biotite gneiss and quartzo-feldspathic gneiss; the major two gneissic rock formations found in Sri Lanka.

Fresh gneissic rock samples were subjected to heating and the weakening of their strength properties were studied upon cooling. Naturally weathered gneissic rock samples belonging to different weathering grades were also tested for their index properties. These were compared with the index properties of artificially weathered fresh gneissic rock samples and some correlations are established.

The rate of deterioration of index properties of quartzo-feldspathic gneiss is seen to be more than that of biotite gneiss. Therefore more attention should be paid in the designing of foundations of important civil engineering structures in quartzo-feldspathic gneiss as far as the durability is concerned, based on the project location.

PREFACE

This report is on "Durability of rocks under tropical conditions". The report is presented in six chapters.

Chapter 1 briefly describes rock formations of Sri Lanka, weathering of rocks and also the importance of this study. This chapter also includes the hypotheses and the objectives of the research.

The methodology adopted and the instruments used in this study are described in Chapter 2.

Chapter 3 describes the initial study on thermal sensitivity of gneissic rocks.

The detailed studies carried out on the thermal sensitivity of biotite gneiss and quartzo-feldspathic gneiss are described in Chapter 4 and 5 respectively.

The concluding remarks and recommendations are given in Chapter 6.

ACKNOWLEDGEMENT

It is my great pleasure to convey my heartiest gratitude to Professor P.G.R. Dharmaratne and Dr. U.G.A. Puswewala of the Faculty of Engineering, University of Moratuwa, as my project supervisors for their continuous guidance and invaluable support extended to me to complete this research.

I also wish to convey my thanks to Professor (Mrs.) N. Ratnayake, Head, Dept. of Civil Engineering for granting permission to use laboratory facilities of the Department of Civil Engineering.

The great assistance given by Eng. Jayantha Dharmaratne, the Quarry Manager of Lanka Quarries (Pvt) Ltd., in the form of providing necessary facilities to collect samples from their quarry sites is highly appreciated.

I also wish to express my gratitude to Eng. W.A.A.W. Bandara, Director, Engineering and Laboratory Services (Pvt) Ltd., for facilitating laboratory testing, and some of them free of charge.

Finally, I gratefully acknowledge the cooperation given by the laboratory staffs of the Department of Civil Engineering and the Department of Earth Resources Engineering, University of Moratuwa to make this project a success.

University of Moratuwa,
Moratuwa,
Sri Lanka.

G.V.I. Samaradivakara

June' 2006

CONTENTS

Page No.

LIST OF ABBREVIATIONS

Abbreviation	*Description*
BG	Biotite Gneiss
QFG	Quartzo-Feldspathic Gneiss
UPV	Ultrasonic Pulse Velocity
UCS	Unconfined Compressive Strength
SI	Slake durability Index
ASTM	American Standards of Testing and Materials
BS	British Standards
ISRM	International Society of Rock Mechanics

LIST OF TABLES

LIST OF FIGURES